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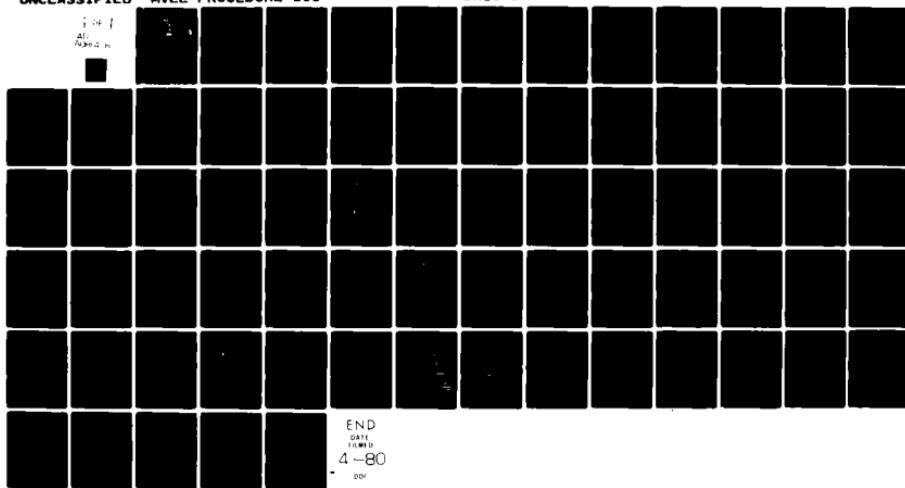
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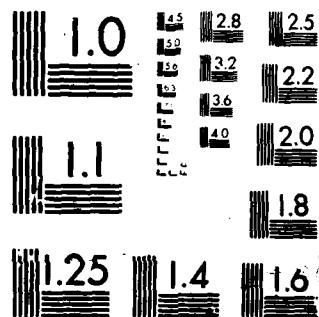
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# CODE OF PRACTICE FOR ENGINEERING DRAWING

Procurement Executive  
Ministry of Defence  
MVEE  
Chobham Lane  
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Surrey KT16 0EE  
United Kingdom

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MILITARY VEHICLES AND ENGINEERING ESTABLISHMENT

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11 September 1979

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FOR  
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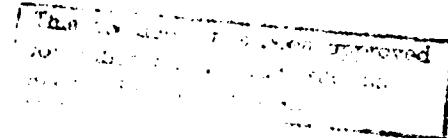
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#### SUMMARY

This Procedure states the application of BS 308 to the preparation of engineering drawings for work for which MVEE is the Design Authority; it also contains additional requirements for specific types of MVEE work. It relates to the form, type etc., of engineering information to be provided on drawings and whilst it is basically complementary to MVEE Procedure 100, Drawing Procedure for Fighting Vehicles and Engineer Equipment, it may also be used with other drawing systems. Some of the most commonly applied Standards, Specifications, Symbols and Abbreviations are listed for reference purposes and examples of completed drawings and diagrams are included.



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## CODE OF PRACTICE FOR ENGINEERING DRAWINGS

## Part One - Introduction

## 1. Scope

- 1.1 This Procedure is issued to state and give guidance in the application of the practices to be used in the presentation of engineering information on drawings prepared by and for MVEE. It is complementary to MVEE Procedure 100 to which reference shall be made for the basic requirements of the MVEE Drawing System.
- 1.2 Wherever practicable and compatible with MVEE requirements, practices specified in Defence and British Standards are to be adopted. Reference should be made to MVEE Technical Services Section for help and guidance on relevant Standards and MVEE Specifications.
- 1.3 MVEE Procedures 100 and 101 supercede MVEE Memorandum 5022 and MVEE (Christchurch) 'Design Office Manual'.
- 1.4
  - 1.4.1 It is important that the relationship between MVEE Procedures 100, 'Drawing Procedures for Fighting Vehicles and Engineer Equipment' and 101 'Code of Practice for Engineering Drawings' is clearly understood. Broadly the relationship is as follows. The purpose of Procedure 100 is to describe the drawing system and the procedures to be followed in order to comply with it. It is essentially concerned with all matters other than the engineering information actually presented on drawings: for example the different types of drawings and associated documents, how drawings are to be kept up to date and how the various spaces ('boxes') in the standard drawing formats are to be completed. The purpose of Procedure 101 is to describe the presentation of engineering information on drawings and the Standards and Specifications for engineering devices, materials to be used and the selection of specific groups of such devices and materials for MVEE work from the broader ranges allowed by the appropriate Standards and Specifications.
  - 1.4.2 A constraint on MVEE procedure 100 however has been the need to keep it very closely aligned to Defence Standard 05-10. In fact much of the material from the Defence Standard has been incorporated in Procedure 100 in order to relieve the reader from having to consult both documents. This has meant that in a few cases it has been necessary to include in Procedure 100 some material (eg the use of metric units) which would, under the provisions of 1.4.1 above, be the concern of Procedure 101. Suitable cross-references have been inserted in the latter Procedure in such cases. Also, following Def Stan 05-10, Procedure 100 includes some completed drawings but it should be noted that these illustrate the system ie., to show what different types of drawings look like, rather than the application of it.

## 2. Application

The requirements of this Procedure are mandatory for all work for which MVEE is the Design Authority but they may also be specified for use with drawing systems other than that stated in MVEE Procedure 100.

### Part Two - General Practices for Specifying and Representing Engineering Information on Drawings

#### 3. Selection of Types and Sizes of Drawings

- 3.1 Drawing types (including Lists etc.) used shall be selected from those specified in MVEE Procedure 100.
- 3.2 Guidance on the types of drawings to be used for certain specific applications is given in Part Five of this Procedure.
- 3.3 The sheet size selected for a drawing or list shall be the smallest which is consistent with the clear presentation of the drawn item and its associated manufacturing information etc.
- 3.4 Generally the single part drawing system as specified in MVEE Procedure 100 shall apply but in certain instances for pre-prototype activities ONLY, it shall be permissible for the Chief Draughtsman, Chertsey or Christchurch as applicable, to authorise the use of combined drawings (as defined in BS 308, Pt 1, clause 3.3). In such cases separate item lists shall be provided.

#### 4. Pencils and Erasers

Care shall be taken to use suitable pencils and leads having smear-proof characteristics and which produce good line contrast for reproduction and micro-filming etc. Specially developed erasers for use on matt surface drafting film shall be used.

#### 5. General Presentation Requirements

##### 5.1 Use of the Drawing System

An illustration of the way in which a typical engineering device (a winch) is represented by a set of drawings meeting the requirements of the MVEE drawing system is given in Figures 1 - 5 as follows:-

- Fig 1 Main assembly drawing
- Fig 1A Drawing List relating to Fig 1
- Fig 1B )
- 1C ) Item List relating to Fig 1
- 1D )
- Fig 2 Sub-assembly relating to Fig 1
- Fig 2A Drawing List relating to Fig 2
- Fig 2B Item List relating to Fig 2
- Fig 3 Sub-assembly relating to Fig 1
- Fig 3A Drawing List relating to Fig 3
- Fig 3B Item List relating to Fig 3
- Fig 4 Welded assembly relating to Fig 1
- Fig 4A Drawing List relating to Fig 4
- Fig 4B Item List relating to Fig 4
- Fig 5 Detail Drawing relating to Fig 4

## 5.2 *Lines*

### 5.2.1 *Types of Lines*

The types of lines used and their presentation shall be in accordance with the requirements and recommendations of BS 308 Part 1, clause 4.

### 5.2.2 *Datum Lines*

Datum lines of main units and assemblies shall be laid down in the initial design stages. All General Arrangement drawings shall clearly define datum lines for main assemblies, eg., CL of turret, CL of rear suspension etc. Subsequent assembly and detail drawings shall also clearly define datum lines as applicable.

### 5.2.3 *Chain Lines*

Chain lines shall be used to indicate

- (a) Alternative and extreme positions of moveable parts
- (b) Essential features of equipment surrounding the titled part or assembly.
- (c) Operational space requirements of equipment or items subject to rotation eg. turret assembly 'sacred circle'.

## 5.3 *Lettering*

The requirements and recommendations of BS 308 Pt 1, clause 5 shall apply. The recommendations of BS 5535 shall also be followed, as applicable.

## 5.4 *Views and Orientation*

### 5.4.1 *Views*

The recommendations of BS 308, Pt 1, clauses 7 and 8 are to be adopted unless contrary requirements are specified.

### 5.4.2 *Orientation*

- (a) Wherever possible all notes on a drawing shall be so placed that they read from the same direction as the format; BS 308 Pt 1, clause 5.4 applies.
- (b) All Arrangement and Assembly drawings shall have their main views orientated in the sense of the main equipment pointing to the left. Detail drawings shall also follow this practice where possible.

## 5.5 *Repetitive Information*

The recommendations of BS 308, Pt 1, clause 7 shall be adopted.

## 5.6 Conventional Representation

Representation of features may be adopted in accordance with BS 308, Pt 1, clause 9 unless full detailing is specified.

## 5.7 Symbols and Abbreviations

5.7.1 Symbols may be used on drawings but they shall be in accordance with those specified in the Standards listed in Table 1. Additional symbols etc., may be used as stated in individual clauses of this Procedure.

5.7.2 A key to the symbols used or their source shall be included in the drawing concerned.

5.7.3 Abbreviations may be used on drawings and lists only if defined in any of the sources in Table 1 or if they are given in App A to this Procedure.

## 5.8 Scales

5.8.1 The recommendations of BS 308 Pt 1, clause 10 shall be applied except as amended in 5.8.2 below.

5.8.2 Where more than one scale is used on a drawing the principal scale shall be indicated in the appropriate panel and a note added thus:

'ORIGINAL SCALE  
-:-, EXCEPT  
AS STATED'

The additional scales shall be stated immediately below the views to which they refer.

5.8.3 See MVEE Procedure 100, Section 8.2 for instructions on the 'Original Scale' box or drawing formats.

## 5.9 Dimensions

5.9.1 The requirements of BS 308, Pt 2 as amplified by MVEE Procedure 100 shall be observed.

5.9.2 Where dimensions are quoted for reference only they shall be shown in brackets thus (75.85) or (16°28').

5.9.3 For certain Service equipments, angular measurements are stated in 'mils.' The mil. or milliradian is defined in Def Stan 00-11, Appendix A, clause 3.

5.9.4 When a dimension is no longer to scale due to alteration, the dimension shall be underlined.

5.9.5 When a drawing is no longer in reasonable proportion due to dimensional alteration, it shall be re-drawn.

## 5.10 Tolerances

### 5.10.1 General

General manufacturing tolerances shall be stated on all drawings where applicable (MVEE Procedure 100, Section 8.11 refers). The tolerances shall be as generous as possible consistent with good engineering practice and the material being used. The tolerances shall always be expressed in the same units of measurement as the dimensions to which they apply.

### 5.10.2 Method of Indicating

The method of indicating tolerances shall be in conformity with BS 308, the preferred form being  $\frac{79.85}{79.66}$ . The form  $\frac{79.85}{79.66}$  is also permissible.

### 5.10.3 Geometrical Tolerances

Where geometrical tolerances are necessary they shall be clearly stated on the drawing in accordance with BS 308 Pt 3.

### 5.10.4 Limits and Fits

Preferred limits and fits shall be as specified in Def Stan 05-19.

## 5.11 Mass

Section 8.10 of MVEE Procedure 100 applies. Metric units are to be used unless otherwise specified by the Approving Authority.

## 6. Units

SI Units as specified in Def Stan 00-11 shall be used wherever possible and as applicable on drawings and in calculations. Guidance in the selection and use of SI units may be obtained from BS 5555 and its associated publication PD 5686. Conversion factors, imperial/metric, shall be in accordance with BS 350 and BS 2856; conversions shall be expressed to an appropriate degree of accuracy only.

## 7. Preferred Numbers and Sizes

The recommendations of BS 6481 shall be adopted when a series or sequence of components or items are designed provided that compatibility with other requirements can be economically achieved.

## 8. Application of Standards

8.1 Some background information on Standards and general guide to how Standards should be selected is given in Appendix B. The basic principle is that if there is a current MVEE specification covering the requirement and no later Defence Standard which also covers the requirement, the MVEE specification shall be used. Otherwise Standards are to be selected in the following order of preference; a lower order shall be used only if the required data or information is not contained in a higher order document:-

Defence Standard (or SDM(L) or SSM(L) where they have not yet been superceded by a Defence Standard)  
Defence Specification, List or Guide  
British Standard  
MOD, other than MVEE Specification or other Government Specification  
Manufacturers Specification

8.2 It is emphasised that for the reasons given in Appendix B, MVEE specifications are produced only when other Defence or British Standards are inadequate and therefore only cover relatively few specialised areas in comparison to the greater range of materials, processes, procedures and items of equipment covered by Defence and British Standards. Examples of areas covered by MVEE specifications are:-

- (a) Armour and associated processes eg. specifications mentioned in Tables 5 and 6.
- (b) Electrical specifications, See Table 7
- (c) Painting of vehicles eg MVEE Specification 666.

8.3 All references shall be to the latest issue of current publications.

8.4 Care shall be taken to ensure that publications quoting imperial data have not been superceded by metric versions.

## Part Three - Selection, Specification and Representation of Engineering Devices

### 9. Screw Threads

9.1 ISO metric screw threads shall be used and designated in accordance with BS 3643, Pts 1, 2 and 3. ISO metric coarse threads shall be selected from the preferred range M6, M8, M10, M12, M16, M20, M24, M30, M36, M42, M48, to reduce possible mismatches with other thread systems and sizes.

9.2 The class of fit required is normally "MEDIUM".

i.e. External threads 6g  
Internal threads 6H.

Other classes of fit may be required and shall be in accordance with BS 1916 and 3643.

- 9.3 Threaded inserts (metric) coiled wire type shall be selected from Def Stan 53-82/1 and designated by NATO Stock Number.
- 9.4 For pipe threads for tubes and fittings refer to BS 2779 or BS 21 - see below.
  - (a) Where the joints are not required to be pressure tight the threads shall be in accordance with BS 2779.
  - (b) Where the joints are required to be pressure tight the threads shall be in accordance with BS 21.
- 9.5 The bonding of threaded joints should be in accordance with MVEE Specification 1283.
- 9.6 For thread symbols and identification marking of threads on manufactured parts refer to Def Stan 05-34.
- 9.7 When designing threaded items, any hexagons, squares or flats required shall be dimensioned to suit standard spanners in accordance with BS 192.

## 10. Fasteners

### 10.1 Screwed Fasteners

The requirements of the following Standards shall apply:-

- 10.1.1 Def Stan 53-11 for general purpose bolts, nuts, screws etc.
- 10.1.2 BS 4174 for self-tapping screws
- 10.1.3 BS 4439 for screwed studs.

Note Zinc electroplated coatings to the BS's listed in the Def Stan 53 group are preferred on all screwed fasteners.

### 10.2 Holes for Screwed Fasteners

- 10.2.1 Clearance holes for bolts and screws shall be selected in accordance with the requirements of BS 4186.
- 10.2.2 'Fitted' bolt holes shall be dimensioned and toleranced to suit the requirement.
- 10.2.3 Drill sizes quoted on drawings shall be in accordance with those specified in Def Stan 51-5.

### 10.3 Rivets

These shall be specified in accordance with Def Stan 53 group, or BS 4620.

NOTE: Pop rivets are not covered by service specification; item lists shall refer to the manufacturers approved code.  
e.g. Rivet - Pop/Domed head/3.2 mm dia x 12 long/Break Stem.  
Supplies - Messrs. XYS Ltd. Code TAP/D/46/BS.  
or "APPROVED EQUIVALENT"

#### 10.4 *Cotter Pins, Split*

**Cotter pins, split, shall be selected in accordance with the requirements of Def Stan 53-10.**

#### 11. **Keys and Keyways**

**Keys and keyways shall be specified in accordance with BS 4235. If, to meet special circumstances it is necessary to use imperial units (MVEE Procedure 100 refers), BS 46 shall be applied.**

#### 12. **Splines and Serrations**

**The requirements of BS 2059 for straight-sided and BS 3550 for involute, splines and serrations shall apply.**

#### 13. **Springs**

**13.1 The requirements of Def Stan 01-4 shall apply.**

**13.2 Springs should not be specially designed for an application unless there is no apparent proprietary or standard item available.**

**13.3 Spring drawings shall be in the form shown in Appendix C to this Procedure which also indicates the minimum information to be given on the drawing. Further guidance may be obtained from BS 1726.**

**13.4 Spring drawings shall state whether tolerances are to apply before or after the application of any protective coating (Section 22 refers).**

**13.5 If a spring is required to pass freely over a shaft or inside a tube, this shall be stated giving the diameter of the shaft or the bore of the tube.**

#### 14. **Gears**

**14.1 Gears shall be specified and drawn in accordance with the requirements of the relevant Standard listed in Table 2 unless contrary instructions are issued by the responsible Project Officer.**

**14.2 The lowest grade or class of gear which will adequately meet the requirement shall be quoted.**

**14.3 Gear geometrical definitions, notations, symbols etc. shall be in accordance with BS 2519.**

**14.4 Spur and helical gear addendum modifications shall be in accordance with BS, PD 6457.**

**14.5 Gear drawings shall show the essential features of the gear. Data shall be given in tabular form on the right-hand side of the drawing. Appendix D give guidance on the form of tables to be used.**

14.6 Heat treatment of gears is referred to in Section 23 of this Procedure.

## 15. Chains and Chainwheels

Wherever possible proprietary items for chains and their wheels shall be employed and listed as a 'NOT DRAWN' item. If it is necessary to prepare chain wheel drawings, data thereon shall be given in accordance with the requirements of BS 228.

## 16. Vehicle Components

Def Stan 07-76 gives a comprehensive list of Standards and Specifications which have been issued for a wide variety of vehicle components eg. Controls, Electrical components, Drain plugs, Fabrics, Hoses, Mirrors etc. Wherever possible the Standards quoted in Def Stan 07-76 shall be applied.

## 17. Templates

17.1 Drawings of templates for profiled sheets shall be full size and not dimensioned.

17.2 Notes on the drawing shall state:

plate thickness,  
plate material specification.

17.3 'Sharp' corners in profiles shall be avoided.

17.4 Wherever possible standard drawing sheets shall be used and given numbers in the appropriate series (MVEE Proc 100 applies) but such numbers shall not be entered into drawing and item lists.

17.5 Section 25 of this Procedure also applies.

## Part Four - Selection, Specification and Representation of Materials and Processes

## 18. Materials

18.1 The requirements of MVEE Procedure 100, Sect 8 shall apply.

Materials for specific applications shall be selected on a cost-effective basis taking into account whole-life requirements eg., manufacturing resources, availability, maintenance and accessibility in service etc. Generally the Development Project Officer shall indicate material specifications to be used.

18.2 Selected material specifications suitable for vehicle applications are quoted in Def Stan 07-76. A more detailed list of current armour material specifications is given in Appendix E to this Procedure.

18.3 Approved timbers and plywoods are stated in MVEE Specification 1123 and BS 1088 and these should be specified if possible but the prevailing supply position should be determined and alternatives quoted if necessary.

18.4 See MVEE Procedure 100 Section 8.4 for instructions on completing the 'Materials' Box on Drawing formats.

## 19. Castings

19.1 The following MVEE specification shall apply:

5030 Steel castings for use on AFV's  
567 Aluminium ingots and castings for use with  
aluminium armour

19.2 When applicable drawings of castings are to indicate the classification of the casting in accordance with MVEE Specification 1137.

19.3 Impregnation sealing shall be specified in accordance with Def Stan 03-1 when required.

## 20. Forgings

20.1 Forging material shall be selected from the following specifications:

BS 970 Steel  
BS 1472 Aluminium  
IT 140 Armour Steel  
(MVEE)

20.2 Forging tolerances shall be to the appropriate requirements of BS 4114.

20.3 As may be required by the importance of a forging to the safety or successful operation of the main equipment, or by the stress levels to which it will be subjected, the following information shall be provided on the forging drawing:-

Required grain flow  
Crack detection requirements  
Any test areas required.

## 21. Surface Texture

21.1 For symbols on drawings refer to BS 308 Pt 2.

21.2 The surface roughness quoted shall always be the maximum roughness allowable consistent with the correct functioning of the part; micro metres are the preferred reference.

21.3 Processes to achieve a particular finish are not generally quoted on a drawing, but when a particular process is essential to produce the correct requirements of a part then the process shall be quoted.

21.4 Typical values of the surface texture obtainable by various machining processes are shown in Appendix F.

21.5 See MVEE Procedure 100 Section 8.3 for instructions on completing the 'Surface texture' box on drawing formats.

## 22. Protective Finishes

22.1 Protective finishes shall be quoted in accordance with the appropriate system given in MVEE Specification 666.

22.2 Defence Guide 10 should be consulted regarding special protective treatment for springs.

22.3 Dimensions and surface roughness values shall apply AFTER any required plating or chemical processing has been carried out. Drawings shall be clearly annotated to this effect.

22.4 See MVEE Procedure 100 Section 8.5 for instructions on completing the 'Protective Finishes' Box on drawing formats.

## 23. Hardening and Heat-Treatment

23.1 Details of hardening and heat treatment to meet design requirements shall be given in note form on the drawing, e.g. case hardening, induction hardening, nitriding, stress relieving etc.

23.2 A typical note would be:-

"Case harden surface shown	xxxxx
Effective case depth	0.8/1.0 mm
Surface hardness	600/650 HV"

23.3 When indicating surface hardness Vickers hardness (HV) values are preferred; see BS 427. Exceptionally, where for instance stress concentration due to indent is to be kept to a minimum e.g. forgings castings etc., Brinell hardness (HB) values are permissible; see BS 240.

## 24. Non-Destructive Testing

24.1 Some related specifications for non-destructive testing (NDT) are given in Table 3.

24.2 Terms used on drawings shall wherever possible be in accordance with glossary in BS 3683.

24.3 Non-destructive testing of a weld shall be indicated by the appropriate symbol (BS 499 Pt 2 refers) placed near to the end of the reference line.

24.4 Radiographic requirements for castings shall be stated on drawings in accordance with the requirements of MVEF Specification 1137.

## 25. Plate Profiling

25.1 When plates are to be flame cut to templates, allowances for flame diameter and subsequent machining requirements are to be made by the manufacturer.

25.2 When the plasma arc process is used to cut armour aluminium, the manufacturer must leave a minimum of 6 mm all round the contour for final machining to eliminate the stress area set up by the cutting process.

## 26. Greases and Lubricants

26.1 For the primary selection of greases and lubricants for service requirements refer to DEF STAN 01-5.

26.2 Greases and lubricants not listed in the above DEF STAN - e.g. newly marketed products - may only be specified if approved by the appropriate MVEE Project Officer.

26.3 For standard range lubrication nipples and adaptors refer to DEF STAN 47-7.

26.4 For standard range grease guns refer to DEF STAN 49-2.

26.5 For the preparation of lubrication charts and instructions refer to MVEE Spec: 2017 and MVEE Procedure 100.

NOTE The preparation of such charts shall be on MVEE standard drawing sheets.

## 27. NC Machining

When parts are machined by a numerical control (NC) system contractors are responsible for the preparation of programming requirements conforming to their particular system.

## Part Five - Preparation of Specific Categories of Drawings

### 28. Drawings and Diagrams for Electrical Systems

#### 28.1 *Installation Drawings*

28.1.1 Radio and electrical installation drawings shall show mounting plates, brackets, fasteners etc, necessary to accommodate components and interconnecting harnesses and wiring; item lists, drawing lists and schedules calling up components and associated drawings shall be prepared. A typical installation drawing is shown at Fig 6.

28.1.2 All details of welded fitments necessary to accommodate electrical equipment shall be shown in chain lines.

NOTE These welded fitments are called up on welded assembly drawings and lists. Planning circumstances may make it necessary to prepare separate welded fitment drawings.

28.1.3 Drawings shall show the run of all interconnecting cables and wire following the approximate run in relation to the structure of the vehicle or equipment.

28.1.4 The equipment called up and forming the installation shall be drawn under its own drawing structure in accordance with MVEE Procedure 100.

## 28.2 Diagrams

### 28.2.1 General

Electrical diagrams are to be prepared in accordance with the requirements of MVEE Procedure 100.

### 28.2.2 Symbols

Electrical symbols on drawings etc., shall be as specified in Def Stan 05-17 but additional symbols required for MVEE work are given in Appendix G to this Procedure.

### 28.2.3 Block Diagrams

- (a) Each item of equipment shown in a Block diagram shall be defined by a continuous thick line surround and identified by its name and drawing number.
- (b) A group of items, shall, if appropriate, be surrounded by a heavy chain line and annotated to indicate its location on the assembly or equipment.
- (c) A typical radio block diagram is shown in Fig 7.

### 28.2.4 Circuit Diagrams

- (a) Components included in circuit diagrams shall be clearly defined by a chain line surround.
- (b) When specified by the Project Officer responsible, special relays and, or, contactors may be designated by functional references.
- (c) A typical vehicle circuit diagram is shown in Fig 8.

### 28.2.5 Wiring Diagrams and Schedules

- (a) Wherever possible, wiring diagrams shall be contained on a single drawing sheet, Fig 9 refers. If this cannot be achieved, the wiring diagram shall be broken down into convenient sections and drawn on multiple drawing sheets, suitably cross-referenced to ensure correct continuity of wiring information, see Fig 10.
- (b) Wiring inside of a component shown on a wiring diagram shall be shown on the wiring schedule or alternatively, be drawn up on a wiring diagram.

(c) The drawing numbers of any applicable cableforms shall be quoted on wiring diagrams.

#### 28.2.6 Interconnection Diagrams

(a) Interconnection diagrams are mainly applied to radio installations but may also be used for electrical or electronic equipment.

(b) Interconnected items shall be defined by full lines and given their full nomenclatures and drawing or part numbers. Connection points shall be indicated diagrammatically and defined.

(c) A typical diagram is shown in Fig 11.

#### 28.2.7 Cableform Diagrams

Cableforms shall be applied only for the installation of radio or electrical items forming the whole or part of an installation in a vehicle or an equipment. A typical cableform diagram is shown in Fig 12.

#### 28.2.8 Harness Assembly Diagrams

All manufacturing information, including end fitting requirements shall be given. The wiring diagram shall be incorporated as shown in Fig 13.

### 28.3 Related Specifications

A list of electrical specifications and standards applying to MVEE requirements is given in Table 7. It is not necessarily complete and will not be automatically up-dated; reference should be made to Technical Services Section, MVEE for further guidance (see also 1.2).

## 29. Drawings and Diagrams for Hydraulic Systems

29.1 Hydraulic systems and layouts shall be depicted by diagrams and items therein depicted by symbols all as recommended or specified in BS 5070 except as may be amended by any of the MVEE requirements stated below.

29.2 The use of special symbols to indicate specific requirements shall be supported by a note or legend indicating the applications.

29.3 Block diagrams shall include tabulation of pipe references, size, type, route, description and pipe identification marking.

29.4 Hydraulic assembly drawings shall be prepared in accordance with the requirements of BS 5070.

29.5 Pipe fittings and associated components such as banjo assemblies, sealing washers etc: shall, where possible, be selected from

(a) FV(S) series standard parts

(b) The Society of British Aircraft Constructors handbook of AGS parts.

- 29.6 The design of oil tanks shall conform to the requirements of MVEE Specification 1131.
- 29.7 Toroidal sealing rings (Imperial) shall be selected from SSM(L)7-17 and the dimensions of housings and recesses be in accordance with BS 1806.
- 29.8 For toroidal sealing rings (Metric) and their associated data refer to BS 4518.
- 29.9 For rotary lip seals (Metric) and their associated data refer to BS 1399.
- 29.10 All pipe couplings shall be wire locked as in FV(S) 105 using 22 s.w.g. locking wire to SSM(L)18-7 to be indicated in note form on the assembly drawing.
- 29.11 Flexible hose assembly drawings shall be prepared to meet the technical requirements stated in DEF STAN 47-2.

#### 30. Drawings and Diagrams for Pneumatic Systems

The recommendations of BS 5070 shall be followed insofar as the selection and preparation of diagram types and their presentation are concerned but the requirements of MVEE Specification 1316 shall be observed, in the preparation of vehicle braking system drawings and diagrams, as applicable.

#### 31. Drawings and Diagrams for Optical Systems

The requirements of BS 4301 shall be observed in the preparation of optical elements and systems; also the recommendations of BS 5070 shall be followed where diagrams are required.

#### 32. Drawings for Fabricated Parts

- 32.1 When preparing drawings of welded assemblies and details reference shall be made to MVEE Memo 77005 'Design procedure for determination of safe working loads for welds in mild steel, armour steel and aluminium alloy armour', or MVEE Memo 77013 'The use of aluminium alloys in Armoured Fighting Vehicles' as appropriate.
- 32.2 Information on special welding processes and procedures is available from MVEE FS/AM branch, Welding and Fabrication Section.
- 32.3 For complicated fabricated parts the drawing shall show the basic structure. Separate welded fitment drawings showing equipment mounting pads, stud welding, etc. shall be prepared where necessary.
- 32.4 When preparing drawings for fabricated parts it is important to give attention to the following:-
  - 32.4.1 The primary means of designating welds on drawings shall be by pictorial representation. See Appendix H.

32.4.2 The terms, symbols and dimensions accompanying pictorial weld representations shall be to BS 499 Pts 1, 2 and 3.

NOTE The practice of placing the symbol below the reference line for welds on the near (arrow) side shall be adopted.

32.4.3 Size of welds shall be indicated, in millimetres, against each symbol used.

32.4.4 In specifying a fillet weld the dimension shall be clearly indicated as the minimum leg length. For obtuse angle fillet welds the design 'throat' dimension in addition to the leg length shall be specified.

32.4.5 Drawings shall give all the information necessary to ensure that assemblies are correctly constructed.

32.4.6 Adequate access to the joint by welding equipment shall be ensured.

32.4.7 Assemblies shall be designed to facilitate visual inspection and non-destructive testing at any stage.

32.4.8 The appropriate standard note, see Appendix J, shall appear on each drawing of a welded part.

32.4.9 For Studs Welding, Metric, see DEF STAN 53-80.

32.5 Master Drawings (MVEE Procedure 100, 8.7.5 and Appendix C refers) shall include the following information as applicable:-

32.5.1 Hull/Turret structure space envelope datum corners appropriately dimensioned in relation to finite faces and/or features.

32.5.2 Full size true section through each welded joint showing:

- (a) Type of weld in situ.
- (b) Dimensions of weld.
- (c) Included weld angle and plate angles.
- (d) Indication of exposed surface (ES) required to withstand ballistic attack.
- (e) Identification and form of parent material.  
(eg MV.....plate, MV.....forging,  
MV..... extrusion, etc).
- (f) Stress Corrosion Prevention treatment, where necessary, See MVEE Memorandum 77013.
- (g) All true sections shall be drawn on one drawing sheet unless the number of sections requires more than one drawing sheet.

32.5.3 Applicable manufacturing process specification(s) listed in Table 4.

32.5.4 An isometric view of the structure illustrating the welding sequence and procedure in accordance with MVEE Spec 1031.

32.6 Detail drawings of individual parts (except armoured castings, forgings, extrusions etc) for fabricated assemblies, do not normally require approval as at 32.5 above, but shall quote the specification(s) listed in Table 5 as applicable.

33. Drawings for Armoured Alloy Castings, Forgings and Extrusions

Master drawings requiring approval in accordance with MVEE Procedure 100, Section 8.7.5 shall show the applicable specification from the list given in Table 6.

TABLES

SUBJECT	SPECIFICATION
General Engineering Terms and Abbreviations	BS 308 Pt 1 - Clause 11
Graphical symbols for geometrical tolerances	BS 308 Pt 3 - Clause 2.1
Graphical symbols for electrical and electronic diagrams	Appendix F to this Proc. and DEF STAN 05-17
Graphical symbols for use in diagrams for hydraulic and pneumatic systems	BS 2917
Welding terms and symbols	BS 499 and Appendix C to this Procedure
Graphical symbols for general engineering	BS 1553
Letter symbols, signs and Abbreviations	BS 1991

Table 1 - Sources for symbols and abbreviations  
(Sections 5.9 and 5.11 refer)

TYPE OF GEAR	SPECIFICATION
Bevel gears	BS 545
Spur gears	BS 436
Master spur gears	BS 3696
Helical gears	BS 436
Worm gears	BS 721 and 3027
Fine pitch gears	BS 978 and 4582

NOTE Refer to BS 6457 for addendum modifications to spur and helical gears.

Table 2 - Standard for gears (Section 14 refers)

SUBJECT	SPECIFICATION
Pipes and Tubes	BS 3889
Plate material	BS 4336
Steel castings	BS 4080
Steel forgings	BS 4124

Table 3 - NDT Standards  
(Section 24 refers)

TITLE	SPECIFICATION
Welding and gas cutting in the construction of fighting vehicles.	MVEE SPEC 1031
Automatic Stud Welders for use in the construction of fighting vehicles.	MVEE SPEC 1032
Electrodes for arc welding and stud welding equipment approved for use on armoured vehicles.	MVEE SPEC 1050
Welding and cutting aluminium alloy armour in the construction of fighting vehicles.	MVEE SPEC 1321
Specification for the repair of production armour castings by welding.	MVEE SPEC 2016

Table 4 - Welding Process Specifications  
(Section 32, 5.3 refers)

SUBJECT	SPECIFICATION
Armour plate preparation for use in the construction of fighting vehicles	MVEE Spec 1096
High strength heat treatable aluminium alloy armour plate 6 - 120 mm thickness	MVEE Spec 1318
Oxygen cutting of rolled armour plate	MVEE Spec 5014
Homogeneous machinable armour plate 15 mm nominal thickness and over	MVEE Spec IT80
Homogeneous machinable armour plate 3 to 14 mm nominal thickness	MVEE Spec IT100
Floor plates for AFV's	MVEE Spec IT 130
Aluminium alloy armour plate, weldable N8	MVEE Spec 570

Table 5 - Armour plate specifications  
(Section 32.6 refers)

SUBJECT	SPECIFICATION
Armour quality castings	MVEE Spec IT 90
Armour quality forgings	MVEE Spec IT 140
Homogeneous aluminium alloy armour extrusions of nom. section thickness 18 mm or over	MVEE Spec 517

Table 6 - Armour casting, forging and extrusion specifications  
(Section 33 refers)

SUBJECT	SPECIFICATION
Electrical and Electronic Components	DEF STAN 59 Group
Electric Wire, Power and Distribution Equipment	DEF STAN 61 Group
Lighting Fixtures and Lamps	DEF STAN 62 Group
Road Lighting of Military Vehicles	DEF STAN 25-5
General Design and Manufacturing Requirements for Service Electronic Equipment	DEF STAN 00-10
General Requirements for the Electrical Equipments of Fighting Vehicles	MVEE Spec 2051
Schedule of Approved General Purpose Electric Cables for use on Fighting Vehicles	MVEE Spec 2052
Design Procedure for Electrical Equipment	MVEE Spec 2055
Responsibilities of Contractors Providing Wiring Systems for FV's	MVEE Spec 2062
General Requirements - Fighting Vehicles Gun Control and Vehicle Mounted Electronic Equipment other than Signal Services	MVEE Spec 1222
Standard Parts (Electrical)	FV(S) Series
Graphical Symbols for electrical power A	BS 3939
Drawing Practice for Engineering Designers	BS 5070
Graphical Symbols for Electrical and Electronic Diagrams	DEF STAN 05-17

Table 7 - Electrical Specifications  
(Section 28.4 refers)

SECURITY CLASSIFICATION	3RD ANGLE PROJECTION																																																																																														
DRAWING NUMBER	FV00123																																																																																														
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FIG.1 ASSEMBLY DRAWING (Illustrating Section 5.1)

SECURITY CLASSIFICATION							
USED ON <b>FV 00195</b>	SIZE	DRAWING No.	ISSUE		SIZE	DRAWING No.	ISSUE
	A4	DRG. LIST FOR FV00123	AS THIS SHEET		A3	FVOO150	1
	A4	ITEM LIST FOR	1		A4	FVOO151	
	A3	FV00123	1				
	A4	DRG LIST FOR FV00124	LATEST ISSUE			DEF STAN 47-7	
		AND ALL DRGS				DEF STAN 53-10	
	A4	DRG LIST FOR FV00125	LATEST ISSUE			DEF STAN 53-18	
		AND ALL DRGS				DEF STAN 53-21	
	A4	DRG LIST FOR FV 00126	LATEST ISSUE			DEF STAN 53-26	
		AND ALL DRGS				DEF STAN 53-27	
						DEF STAN 53-31	
	A3	FVOO140	1			DEF STAN 53-52	
	A3	FVOO141	1				
	A4	FVOO142	1			MVEE SPEC 666	
	A4	FVOO143	1				
	A4	FVOO144	2			FV(S) 69	MVEE
	A3	FVOO145	1				
	A4	FVOO146	1				
	A4	FVOO147	1				
	A3	FVOO148	1				
WORK STAGE	CHECKED	CERTIFIED	SEALED				
PRE-PROTOTYPE							
PROTOTYPE	T. Atkins	R. Crown					
APP/PDR	N. Gorn	R. Crown	1	1-9-76	570	5611	
PRODUCTION	N. Gorn	J. Sweet.	①	ISS	DATE	ALT.No.	APPD
CONTRACTOR	A & B LTD						
ORIG. CONTRACT No.							
DRAWN K.WHITFIELD	PROCUREMENT EXECUTIVE (MOD) - MVEE						
ORIGINAL DATE 20-9-75	TITLE <b>WINCH ASSEMBLY</b>					DRG. LIST FOR DRG. No. <b>FV 00123</b>	SHEET No. 1 OF 1
	PC TITLE						

210mm x 297mm

FIG. 1A DRAWING LIST FOR ASSEMBLY DRAWING (illustrating Section 5.1)

SECURITY CLASSIFICATION						
USED ON	ITEM	DRAWING No.	TITLE		No.OFF	REMARKS
FV 00195		FVOO123	WINCH ASSEMBLY			
	1	FVOO124	HANDLE		1	
	2	FVOO125	CATCH		1	
	3	FV. 00126	DRUM		1	
	4					
	5	FVOO140	WORM		1	
	6	FVOO141	WORM WHEEL		1	
	7	FVOO142	WORM SPINDLE		1	
	8	FVOO143	SPINDLE		1	
	9	FVOO144	COLLAR		1	
	10	FVOO145	CASE		1	
	11	FVOO146	COLLAR		2	
	12	FVOO147	DISTANCE PIECE		1	
	13	FVOO148	DISTANCE PIECE		1	
	14	FVOO149	BRACKET		1	
	15	FVOO150	BRACKET		1	
	16	FVOO151	CLIP		1	
	17					
	18					
WORK STAGE	CHECKED	CERTIFIED	SEALED			
PRE-PROTOTYPE						
PROTOTYPE	T. Atkins	R. Brown				
APP	N. Green	R. Brown	1	1-9-76	570	5611
PRODUCTION	N. Green	of Sweet ①	ISS	DATE	ALT.No.	APPD
CONTRACTOR	A & B LTD.		SECURITY CLASSIFICATION			
ORIG. CONTRACT No.						
DRAWN K. WHITFIELD	PROCUREMENT EXECUTIVE (MOD)-MVEE		CONTRACTORS REF. No.			
ORIGINAL DATE 20-9-75	TITLE  WINCH ASSEMBLY		ITEM LIST FOR DRG. No.  FVOO123		SHEET No. 1 OF 3	A
PC TITLE						4

210mm x 297mm

FIG.1B ITEM LIST FOR ASSEMBLY DRAWING (illustrating Section 5.1)

## SECURITY CLASSIFICATION

USED ON FV00195	ITEM	DRAWING No.	TITLE		No.OFF	REMARKS
	19					
	20					
	21	DEF STAN 53 - 18	BOLT, HEX HEAD, STEEL		1	M6X30LONG
		TABLE I (B)	5306-99-122-5245			
	22	DEF STAN 53 - 21	SCREW, HEX HEAD, STEEL		4	M16X25LONG
		TABLE I (B)	5305-99-122-8682			
	23					
	24	DEF STAN 53 - 26	NUT, SLOTTED, HEX, STEEL		1	M6
		TABLE I (B)	NATO No. NOT ALLOCATED			SERIAL No.012
	25	DEF STAN 53 - 27	NUT, HEX, STEEL		2	M6
		TABLE I (E)	5310-99-122-5295			
	26	DEF STAN 53 - 27	NUT, HEX, STEEL		4	M8
		TABLE I (E)	5310-99-122-5296			
	27					
	28	DEF STAN 53 - 31 PART 3	WASHER LOCK SINGLE COIL STEEL		2	
		TABLE I (B)	5310-99-137-9232			M6
	29	DEF STAN 53 - 31 PART 3	WASHER LOCK SINGLE COIL STEEL		4	
		TABLE I (B)	5310-99-138-9227			M8
WORK STAGE	CHECKED	CERTIFIED	SEALED			
PRE-PROTOTYPE						
PROTOTYPE	T. Atkins	R. Brown				
APP	N Green	R Brown	1	1-9-76	570	5611
PRODUCTION	N Green	J Sweet ①	ISS	DATE	ALT.No.	APPD
CONTRACTOR A & B LTD						
ORIG. CONTRACT No.						
DRAWN KWHITFIELD	PROCUREMENT EXECUTIVE (MOD)-MVEE					CONTRACTORS REF. No.
ORIGINAL DATE 20-9-75	TITLE <b>WINCH ASSEMBLY</b>				ITEM LIST FOR DRG. No.	SHEET No. 2 OF 4
	PC TITLE				<b>FV00123</b>	

210mm x 297mm

FIG. 1C ITEM LIST CONTINUATION SHEET FOR ASSEMBLY DRAWING

**SECURITY CLASSIFICATION**

USED ON	ITEM	DRAWING NO.	TITLE				No.OFF	REMARKS
FV00195	30							
	31	DEF STAN 53 - 10	PIN, COTTER, SPLIT.		1	1/16 X 5/8		
		TABLE I (B)	5315-99-948-6478					
	32	DEF STAN 53 - 52	PIN, TAPERED, PLAIN, SOLID		1	3/16 X 1 1/4		
		TABLE I (B)	5315-99-942-1099					
	33	DEF STAN 53 - 52	PIN TAPERED, PLAIN, SOLID		4	1/4 X 1 1/4		
		TABLE I (B)	5315-99-942-0861					
	34							
	35	FV(S) 69 / 14	KEY WOODRUFF		3	1/4 X 1		
			NATO No. NOT ALLOCATED					
	36	FV(S) 69 / 5	KEY WOODRUFF		1	1/8 X 5/8		
			NATO No. NOT ALLOCATED					
	37	DEF STAN 47 - 7	LUBRICATING NIPPLE, STRAIGHT		1	3/8 UNF		
		TABLE I (A)	4730-99-943-9377					
WORK STAGE	CHECKED	CERTIFIED	SEALED					
PRE-PROTOTYPE								
PROTOTYPE	T. Atkins	R. Brown	2	11976	575	5620		
APP	N. Green	R. Brown	1	1-9-76	570	5611		
PRODUCTION	N. Green	J. Sweet ①	ISS	DATE	ALT. NO.	APPD	ISS	DATE
CONTRACTOR A & B LTD.								
ORIG. CONTRACT NO.							SECURITY CLASSIFICATION	
DRAWN K. WHITFIELD	PROCUREMENT EXECUTIVE (MOD) - MVEE				CONTRACTORS REF. NO.			
ORIGINAL DATE 20.9.75	TITLE WINCH ASSEMBLY				ITEM LIST FOR DRG. NO.		SHEET No. 3 OF 4	
	PC TITLE				FV00123			

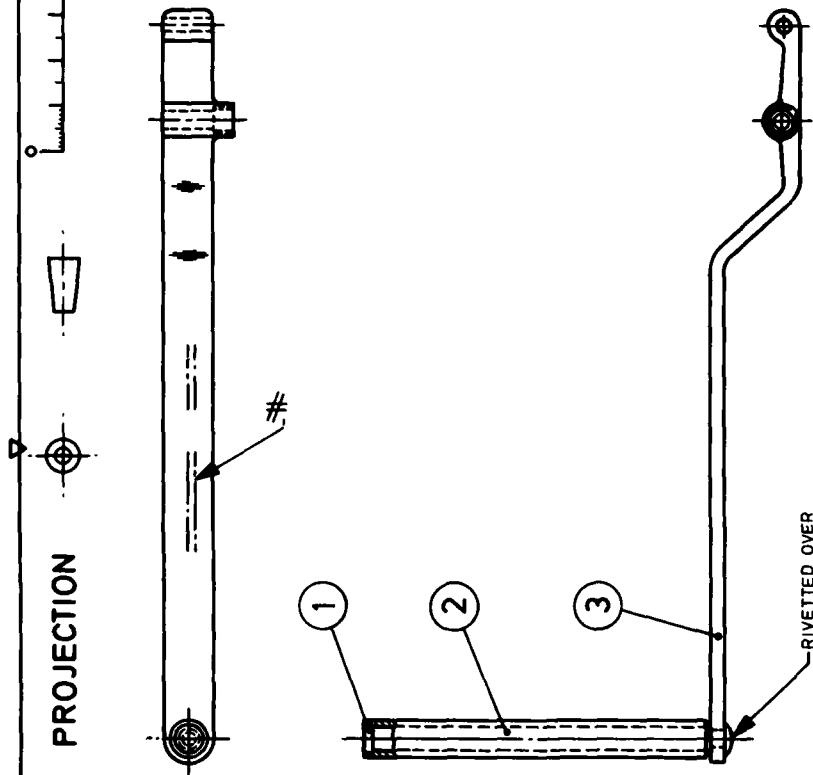
210mm x 297mm

FIG. 1D ITEM LIST CONTINUATION SHEET FOR ASSEMBLY DRAWING

SECURITY CLASSIFICATION	FV00124	
DRAWING NUMBER	FV00123	

**3RD ANGLE PROJECTION**

100  
50  
100 MILLIMETRES FULL SIZE



WORK STAGE	CHECKED	CERTIFIED	SEALED			SECURITY CLASSIFICATION
			REMOVE ALL SHARP EDGES AND CORNERS.	DRAWN IN ACCORDANCE WITH BS 308	DEF. STAN 05-10 AND MVEE PROCEDURE 100 AS APPLICABLE.	
PROTOTYPE	T. Attwood	<i>C. Brown</i>				
APP	N. J. Morris.	<i>R. Brown</i>	MARK DRG. N. & MAKERS APPD			
PRODUCTION	N. J. Morris.	<i>O. J. Sweet</i>	SPEC. SYMBOL WHERE SHOWN *			
DRAWN	ORIGINAL SCALE	ESTIMATED MASS	MATERIAL	SERVICES SPEC	CONTRACTORS SPEC	CONTRACTOR A & B LTD
J. SMITH	1:2	0.43 kg	SEE DETAILS			ORIGINAL CONTRACT NO.
ORIGINAL DATE	20-9-75	—	FINISH	MVEE SPEC 666	—	PROCUREMENT EXECUTIVE
			PAINT	PT4 (EXT)		(MOD) - MVEE
						TITLE
						HANDLE
						MATO STOCK NO.
						P/C TITLE

297mm x 420mm

FIG. 2 SUB-ASSEMBLY DRAWING FOR FIG.1 (illustrating Section 5.1)

**SECURITY CLASSIFICATION**

210mm x 297mm

FIG. 2A. DRAWING LIST FOR SUB-ASSEMBLY (illustrating Section 5.1)

SECURITY CLASSIFICATION

210mm x 297mm

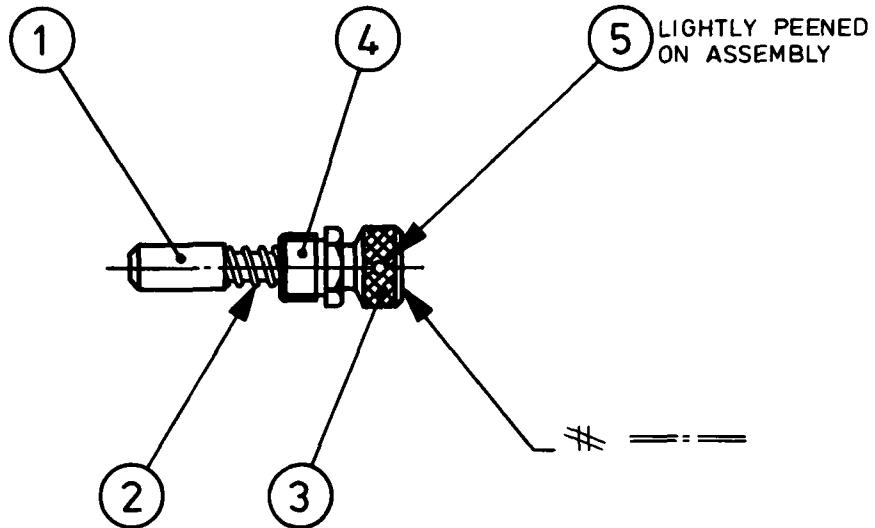
FIG. 2B. ITEM LIST FOR SUB-ASSEMBLY IN FIG. 2 (illustrating Section 5.1)

SECURITY CLASSIFICATION

3RD ANGLE PROJECTION

USED ON  
FV001230  
50  
50 MILLIMETRES FULL SIZE

REMOVE ALL SHARP EDGES AND CORNERS.  
DRAWN IN ACCORDANCE WITH BS 308  
DEF STAN 05-10 AND MVEE PROCEDURE 100 AS APPLICABLE  
MARK DRG. No. AND MAKERS APPD  
SYMBOL WHERE SHOWN #



WORK STAGE	CHECKED	CERTIFIED	SEALED															
PRE-PROTOTYPE																		
PROTOTYPE	T. Atkins	R. Brown																
APP/PDR	N. Green	R. Brown	1	1-9-76	570	5611												
PRODUCTION	N. Green	J. Sweet	①	ISS	DATE	ALT. No.	APPD	ISS	DATE	ALT. No.	APPD							
ORIGINAL SCALE	ESTIMATED MASS			MATERIAL	SERVICE SPEC			CONTRACTORS SPEC										
1:1	0.15 kg			SEE DETAILS														
DIMS IN mm	TOLERANCES			FINISH														
CONTRACTOR A & B LTD.					SECURITY CLASSIFICATION													
ORIG CONTRACT No.																		
DRAWN J SMITH	PROCUREMENT EXECUTIVE (MOD) - MVEE				CONTRACTORS DRG. No.													
ORIGINAL DATE 20-9-75	TITLE CATCH							SHEET		No. 1 OF 1								
	NATO STOCK No.							A		4								
PCT TITLE																		

210mm x 297mm

FIG. 3 SUB-ASSEMBLY DRAWING FOR FIG. 1 (illustrating Section 5.1)

SECURITY CLASSIFICATION							
USED ON	SIZE	DRAWING No.	ISSUE	SIZE	DRAWING No.	ISSUE	
FVOO123	A4	DRG LIST FOR FVOO125	AS THIS SHEET				
	A4	ITEM LIST FOR FVOO125	I				
	A4	FVOO125	I				
	A4	FVOO130	I				
	A4	FVOO131	I				
	A4	FVOO132	I				
	A4	FVOO133	I				
WORK STAGE	CHECKED	CERTIFIED	SEALED				
PRE-PROTOTYPE							
PROTOTYPE	T. Atkins	R. Brown					
APP/PDR	N. Green	R. Brown	1	1-9-76	570	5611	
PRODUCTION	N. Green	J. Sweet ①	ISS	DATE	ALT.No.	APPD	
CONTRACTOR	A & B LTD				SECURITY CLASSIFICATION		
ORIG. CONTRACT No.							
DRAWN J. SMITH	PROCUREMENT EXECUTIVE (MOD) - MVEE				CONTRACTORS REF. No.		
ORIGINAL DATE 20-9-75	TITLE <b>CATCH</b>				DRG. LIST FOR DRG. No. <b>FVOO125</b>		SHEET No. 1 OF 1
PC TITLE							A 4

210mm X 297mm

FIG. 3A. DRAWING LIST FOR SUB-ASSEMBLY IN FIG. 3 (illustrating Section 5.1)

## SECURITY CLASSIFICATION

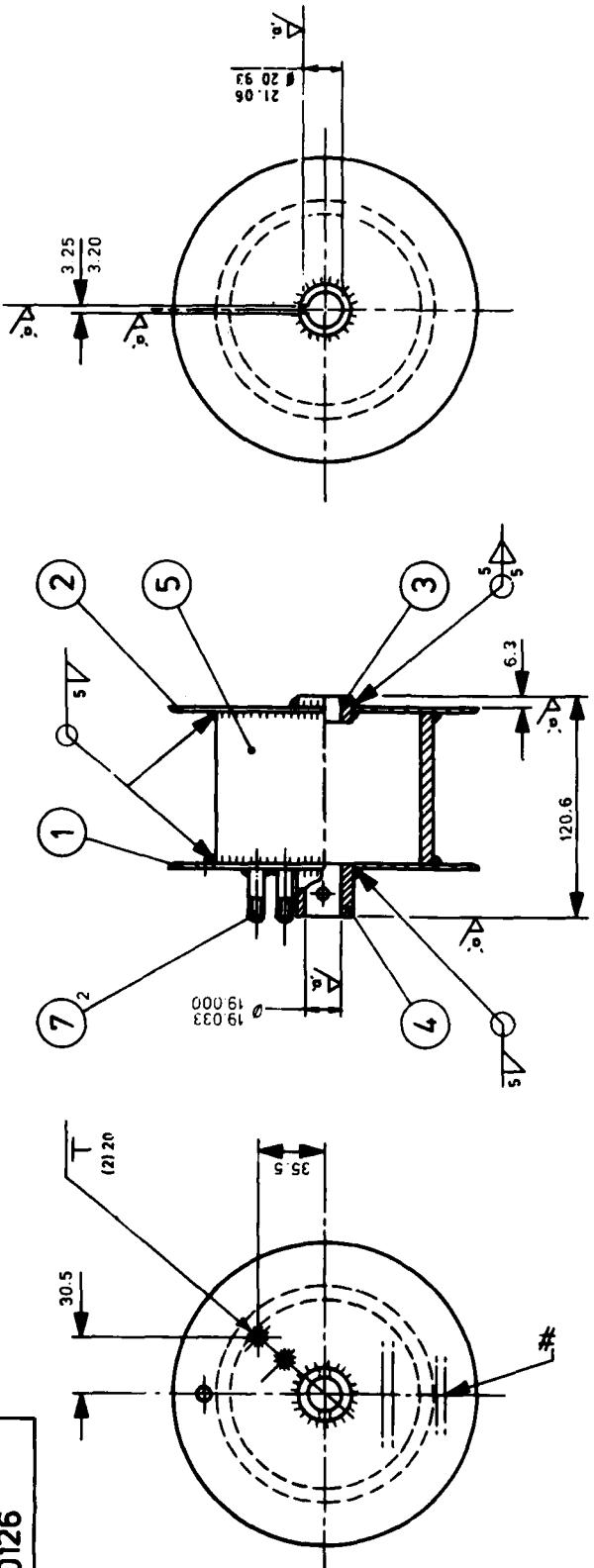
USED ON	ITEM	DRAWING No.	TITLE			No.OFF	REMARKS
FVOO123	FVOO125		CATCH				
	1	FVOO130	PLUNGER			1	
	2	FVOO131	SPRING			1	
	3	FVOO132	KNOB			1	
	4	FVOO133	RETAINER			1	
	5	ND	PIN Ø 2.5 X 22 LG			1	BS970 070M20
WORK STAGE	CHECKED	CERTIFIED	SEALED				
PRE-PROTOTYPE							
PROTOTYPE	T. Atkins	R. Brown					
APP/PDR	N. Green.	R. Brown	1	1-9-76	570	5611	
PRODUCTION	N. Green.	J. Sunt	①	ISS	DATE	ALT.No.	APPD
CONTRACTOR A & B LTD.							
SECURITY CLASSIFICATION							
ORIG. CONTRACT No.							
DRAWN K.WHITFIELD	PROCUREMENT EXECUTIVE (MOD)-MVEE			CONTRACTORS REF. No.			
ORIGINAL DATE 20.9.75	TITLE CATCH			ITEM LIST FOR DRG.No. FV00125			
	PCTITLE						

210mm x 297mm

FIG. 3B ITEM LIST FOR SUB-ASSEMBLY IN FIG 3 (illustrating 51)

SECURITY CLASSIFICATION	DRAWING NUMBER
	F.V. 00126

3RD ANGLE PROJECTION



**WELDING AND GAS CUTTING  
TO CONFORM TO MVEE  
SPEC 1031**

△ = AFTER WELDING

WORK STAGE	CHECKED	CERTIFIED	REMOVE ALL SHARP EDGES AND CORNERS. DRAWN IN ACCORDANCE WITH BS 308			SEALED		
PRE-PROTOTYPE			DEF STAN OS-1C AND MVEE PROCEDURE 100 AS APPLICABLE.					
PROTOTYPE	T. Rebsa R. Brown	R. Brown	MARK DRG No AND MAKERS APPD					
APD/PDR	N. G. Head	R. Brown	SMBOL WHERE SHOWN <u>100</u>					
PRODUCTION	N. G. Head	① J. Sweet				SECURITY CLASSIFICATION		
ORIGINAL DRAWN	ORIGINAL SCALE	ESTIMATED MASS	MATERIAL	SERVICES	SPEC	CONTRACTORS	A & B LTD	CONTRACTORS DRG No.
K WHITFIELD	1.2	1.26 kg	SEE DETAILS	—	—	ORIGINAL CONTRACT No.		
ORIGINAL DATE	20-9-75	DIMS IN	TOLERANCES	FINISH	MVEE SPEC 666 PTL (EXT.)	PROCUREMENT EXECUTIVE (MOD) - DGFVE	DRUM	SERVICE DRG. No.
	mm	mm	0.25 EXCEPT AS STATED	PAINT	—	TITLE	F.V. 00126	SHEET No 1 Of 1
						NATO STOCK No.		
						PC TITLE		

FIG. 4 WELDED SUB-ASSEMBLY FOR FIG.1 (illustrating Section 5.1)

SECURITY CLASSIFICATION

210mm x 297mm

**FIG. 4A. DRAWING LIST FOR WELDED SUB-ASSEMBLY IN FIG. 4 (ILLUSTRATING SECTION 5.1)**

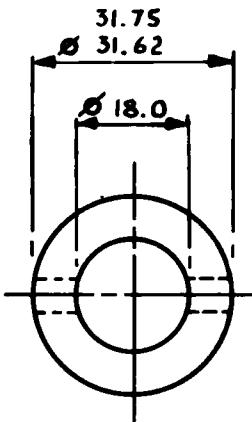
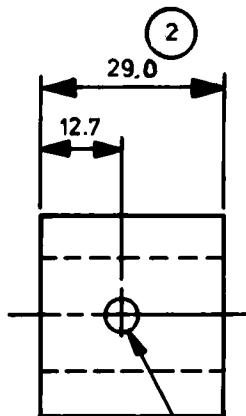
**SECURITY CLASSIFICATION**

210mm x 297mm

FIG. 4B ITEM LIST FOR WELDED SUB-ASSEMBLY IN FIG. 4 (Illustrating Section 5.1)

SECURITY CLASSIFICATION

3RD ANGLE PROJECTION

USED ON  
F.V.001260 50  
50 MILLIMETRES FULL SIZEREMOVE ALL SHARP EDGES AND CORNERS.  
DRAWN IN ACCORDANCE WITH BS 308  
DEF. STAN OS - 10 AND MVEE PROCEDURE 100 AS APPLICABLE  
MARK DRG. No. AND MAKERS APPD  
SYMBOL WHERE SHOWNDRILL Ø 5.6 PILOT HOLE  
FOR Ø 6.3 TAPER PIN

WORK STAGE	CHECKED	CERTIFIED	SEALED															
PRE-PROTOTYPE																		
PROTOTYPE	T. Evans	R. Brown	2	11-9-76	57.5	5620												
APP/PDR	N. Green		1	1-9-76	570	5611												
PRODUCTION	N. Green	J. Sweet ①	ISS	DATE	ALT.No.	APPD	ISS	DATE	ALT.No.	APPD								
ORIGINAL SCALE 1:1	ESTIMATED MASS		MATERIAL		SERVICE SPEC			CONTRACTORS SPEC										
	.11 kg		STEEL		BS 970 070 M20			—										
DIMS IN mm	TOLERANCES ±0.25 EXCEPT AS STATED			FINISH	—			—										
CONTRACTOR A & B LTD					SECURITY CLASSIFICATION													
ORIG CONTRACT No.																		
DRAWN J. SMITH	PROCUREMENT EXECUTIVE (MOD) -				CONTRACTORS DRG. No.													
ORIGINAL DATE 20-9-75	TITLE BOSS				SERVICE DRG. No.			SHEET No. 1 OF 1										
	NATO STOCK No				F.V.00137													
PC TITLE																		

210mm x 297mm

FIG.5 DETAIL DRAWING FOR WELDED ASSEMBLY IN FIG.4 (illustrating Section 5.1)

**FIG.6 RADIO INSTALLATION DRAWING (illustrating Section 23.1.1)**

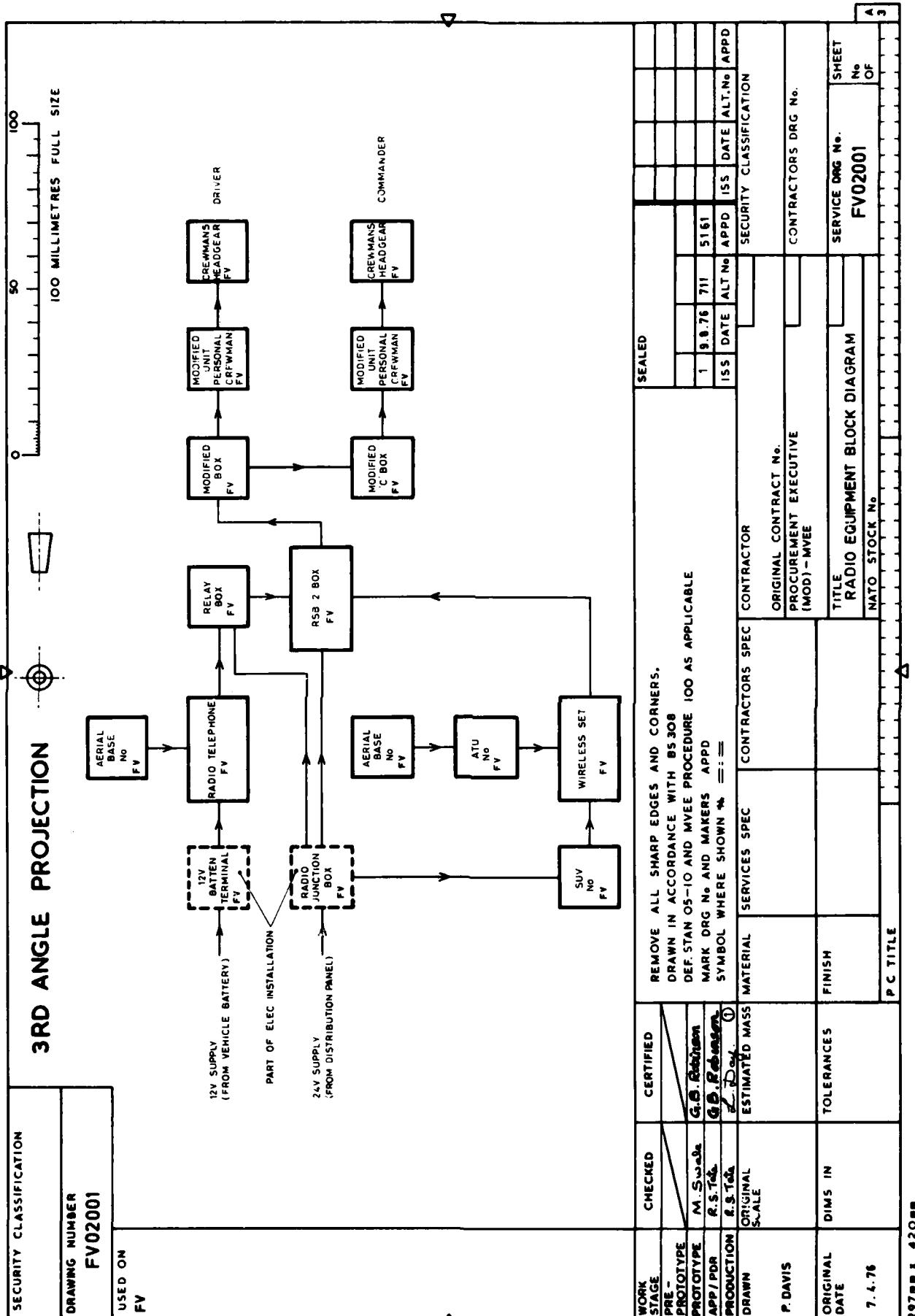


FIG.7 RADIO EQUIPMENT BLOCK DIAGRAM (illustrating Section 28.2.3)

SECURITY CLASSIFICATION	FV02006	
USED ON	FV	

### 3RD ANGLE PROJECTION

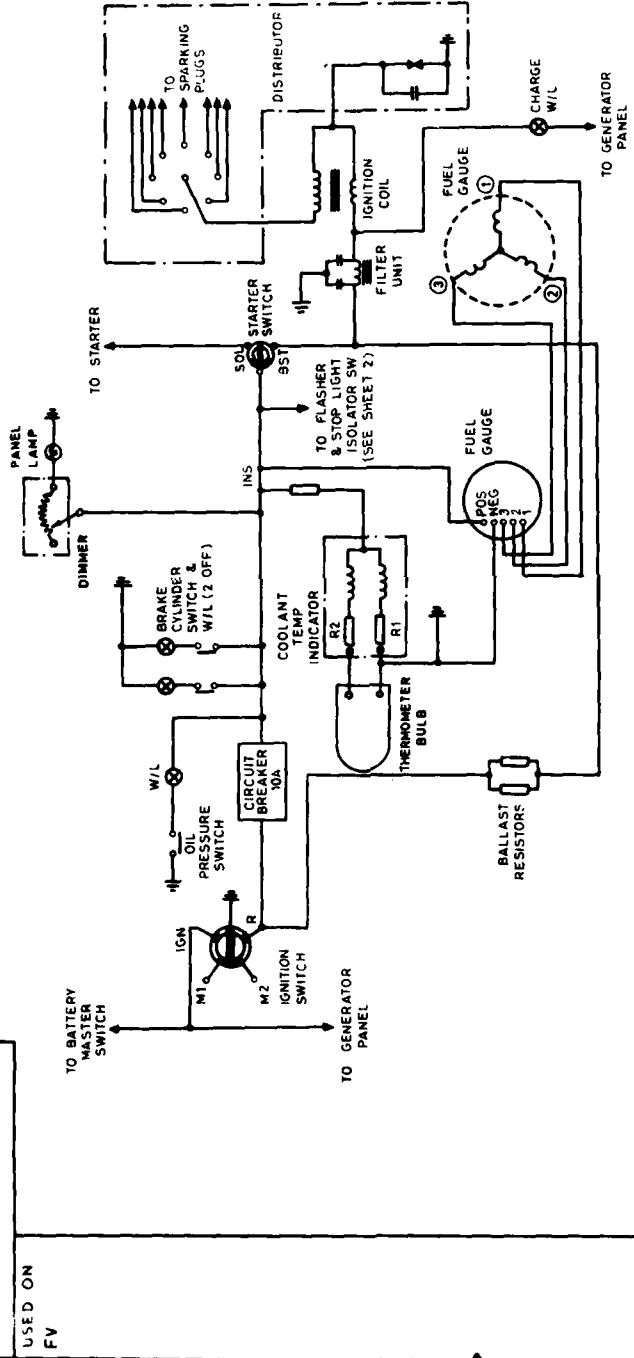


FIG. 8 VEHICLE ELECTRICAL CIRCUIT DIAGRAM (Illustrating Section 28.2.4)

WORK STAGE	CHEKED	CERTIFIED	REMOVED ALL SHARP EDGES AND CORNERS. DRAWN IN ACCORDANCE WITH BS 308 DEF. STAN 0-10 AND MVEE PROCEDURE 100 AS APPLICABLE.			
PRE-PROTOTYPE	<u>M. Singh</u>	<u>C.B. Robinson</u>	1	9.8.76	711	5161
PROTOTYPE	<u>M. Singh</u>	<u>C.B. Robinson</u>	ISS DATE	ALT No	APFD	ISS DATE
APP/PDR	<u>R.S. Tate</u>	<u>C.B. Robinson</u>	ALTERNATE	APPROVAL	ISSUE	ALTERNATE
PRODUCTION	<u>R.S. Tate</u>	<u>C.B. Robinson</u>	Symbol where shown	APPROVAL	ISSUE	APPROVAL
DRAWN	<u>Optical Scale</u>	<u>Optical Scale</u>	ESTIMATED MASS	SERVICES SPEC	CONTRACTORS SPEC	CONTRACTOR
P. PLAT						
ORIGINAL DATE	23.4.76	TOLENCES	FINISH			
P.C. TITLE		CIRCUIT DIAGRAM (VEHICLE)				
		SERIAL DRG. NO. FV02006				SHEET NO. OF 3
		CONTRACTORS DRG. NO.				
		SERVICE DRG. NO.				
		NATO STOCK NO.				

FIG. 9 WIRING DIAGRAM (illustrating Section 28.2.5)

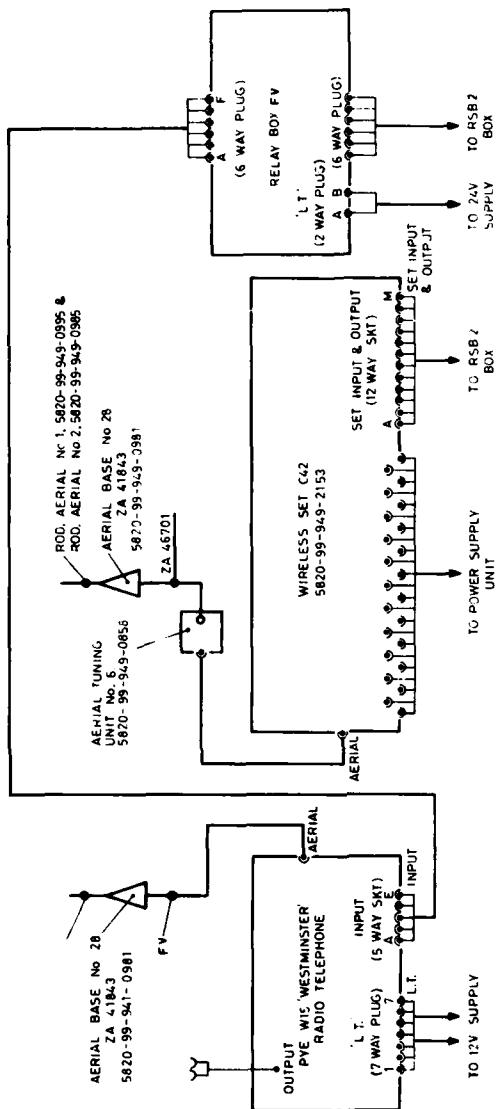
**FIG.10 WIRING DIAGRAM (illustrating Section 28.2.5)**

SECURITY CLASSIFICATION	
DRAWING NUMBER	FV02008
USED ON	FV

### 3RD ANGLE PROJECTION

100  
90  
80  
70  
60  
50  
40  
30  
20  
10  
0

100 MILLIMETRES FULL SIZE



WORK STAGE	CHECKED	CERTIFIED	SEALED			SECURITY CLASSIFICATION
			PRE -	DRAWN IN ACCORDANCE WITH BS 308	DEF. STAN 05-10 AND MVEE PROCEDURE 100 AS APPLICABLE	
PROTOTYPE						
PROTOTYPE	M. S. <u>Johns</u>	G. B. <u>Robinson</u>				
APP/PRO	R. S. <u>Tate</u>	G. B. <u>Robinson</u>				
PRODUCTION	R. S. <u>Tate</u>	G. B. <u>Robinson</u>				
DRAWN	P. <u>Platt</u>	D. <u>Davies</u>				
ORIGINAL						
SCALE						
P. PLATT						
ORIGINAL DATE	12.4.76					
DIMS IN						
TOLERANCES						
FINISH						
P.C TITLE						

P. PLATT

D. Davies

G. B. Robinson

R. S. Tate

M. S. Johns

G. B. Robinson

Johns

Robinson

Tate

Davies

Platt

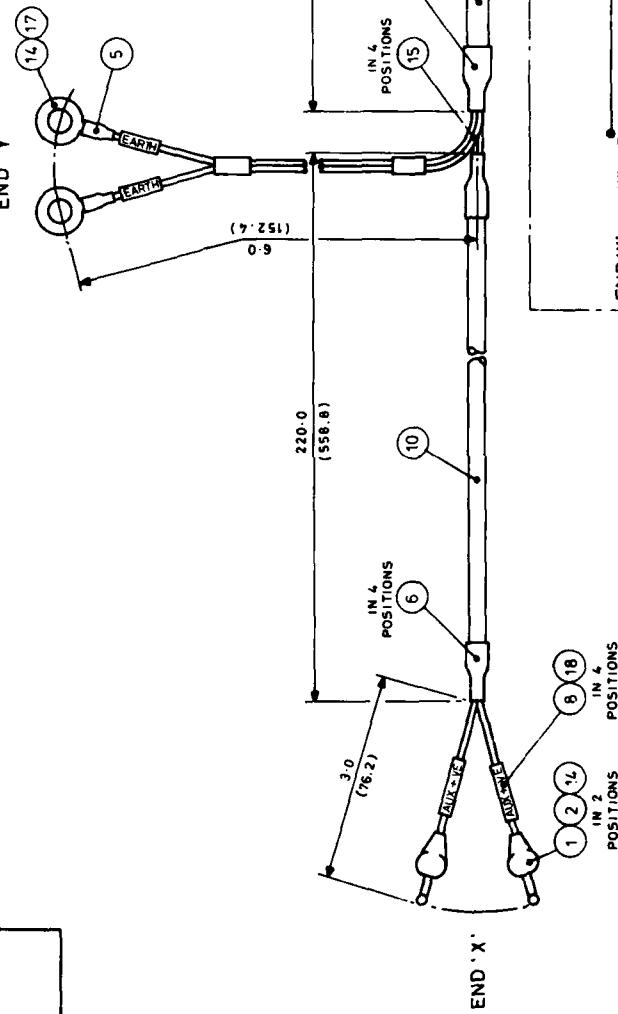
Robinson

Johns

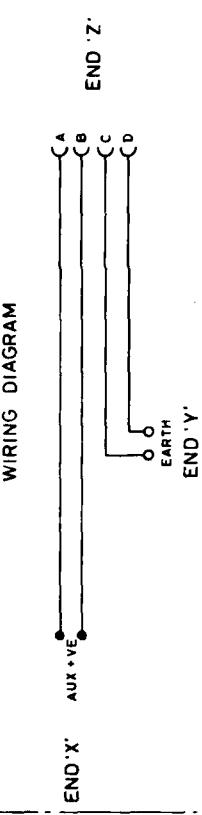
Robinson

FIG. 12 CABLEFORM DRAWING (illustrating Section 28.2.7)

SECURITY CLASSIFICATION

DRAWING NUMBER  
**FV02010**USED ON  
**FV****3RD ANGLE PROJECTION**100 MILLIMETRES FULL SIZE  
100  
50  
0

NOTES  
 1. MARK ITEMS 6 & 9 WITH ITEM 18 AS INDICATED.  
 2. AND THEN CUT OFF SURPLUS LENGTH.  
 2 FOR GENERAL INFORMATION ON  
 HARNESS MANUFACTURE, SEE



WORK STAGE	CHECKED	CERTIFIED	REMOVE ALL SHARP EDGES AND CORNERS. DRAWN IN ACCORDANCE WITH BS 300 DEF STAN 05-10 AND MVEE PROCEDURE 100 AS APPLICABLE. MARK DRG No. AND MAKERS APPD SYMBOL WHERE SHOWN ==:==	CONTRACTORS SPEC	CONTRACTOR	ORIGINAL CONTRACT No. PROCUREMENT EXECUTIVE (MOD) - MVEE	CONTRACTORS DRG No.	SERVICE DRG. No.	SHEET No OF
PRE- PROTOTYPE									
PROTOTYPE	M. S. <u>Swain</u>	G. B. <u>Robinson</u>				1 9876 711	5161		
APP/PDR	R. S. <u>Taylor</u>	G. B. <u>Robinson</u>				ISS DATE	ALT. No.	APPD	ISS DATE
PRODUCTION	R. S. <u>Taylor</u>	<u>D. G. <del>Robinson</del></u>							
DRAWN	ORIGINAL SCALE	ESTIMATED MASS	MATERIAL SERVICES SPEC						
P DAVIS									
ORIGINAL DATE	DIMS IN mm		TOLENCES	FINISH					
10 4 76									
			P C TITLE						

297mm x 420mm

FIG. 13 CABLE HARNESS DRAWING (illustrating Section 28.2.8)

ABBREVIATIONS (SECTION 5.7 REFERS)

- A1. When an abbreviation is specified in this Procedure or any of the associated documents to which it makes reference, that abbreviation and no other shall be used. Terms or words for which no abbreviation is specified may be abbreviated provided that ambiguity is avoided and the meaning is clear.
- A2. Abbreviations should be followed by a full stop ONLY when they form another word eg PRESS. for pressure.
- A3. Unless otherwise specified, all abbreviations on drawings shall be in upper case letters.
- A4. The following list gives approved abbreviations which may be used on MVEE drawings in addition to those given in BS 308 and BS 1991 all of which are mandatory:

<u>Term</u>	<u>Abbreviation</u>
And	&
Approved	APPD
Approximate	APPROX
Centre of gravity	CG
Circular pitch	CP
Circumference	CIRC
Code Number	CODE NO.
Diametral pitch	DP
Dimension	DIM
Horizontal	HORIZ
Left hand	LH
Manufacture(d)	MANUF
Module	M
Printed Wiring Board	PWB
Pressure	PRESS.
Numerical Control	NC
Reference	REF
Reference number	REF NO.
Right hand	RH
Specific gravity	SP GR
Temperature	TEMP
Thick	THK
Thread	THD
Through	THRO
Tolerance	TOL
Vacuum	VAC
Vertical	VERT

STANDARDS (SECTION 8 APPLIES)

- B1. When selecting Standards or Specifications to be applied in the design of equipment and the way in which these Standards are called up on a drawing it is important to appreciate the considerations which govern whether or not a particular standard or specification is produced in the first place.
- B2. In general a Defence Standard (or its equivalent eg SDM(L)) covering a particular area is only produced when either there is no British Standard covering that area, or there is a British Standard but which is considered by the MOD to be in some way inadequate (eg the range of acceptable alternatives allowed is too wide) for Defence purposes.
- B3. Exactly the same considerations apply to the production of MOD Divisional Standards (of which MVEE Specifications and Procedures are an example) in relation to Defence or British Standards. A MVEE specification will only be produced if there is either no Defence or British publication covering a particular aspect of work, or existing Standards are in some way inadequate for MVEE's particular circumstances.
- B4. Normally a MVEE specification covering an area for which there is no adequate Defence Standard will be put up to the Directorate of Standardization for adoption as a Defence Standard if it is considered to be of wide enough application, and if a Defence Standard is issued the MVEE specification is withdrawn.
- B5. Further background information on Standards is given in Appendix 'Q' to MVEE Procedure 110.
- B6. The procedure for selecting Standards is given in the flow diagram at Figure B1.

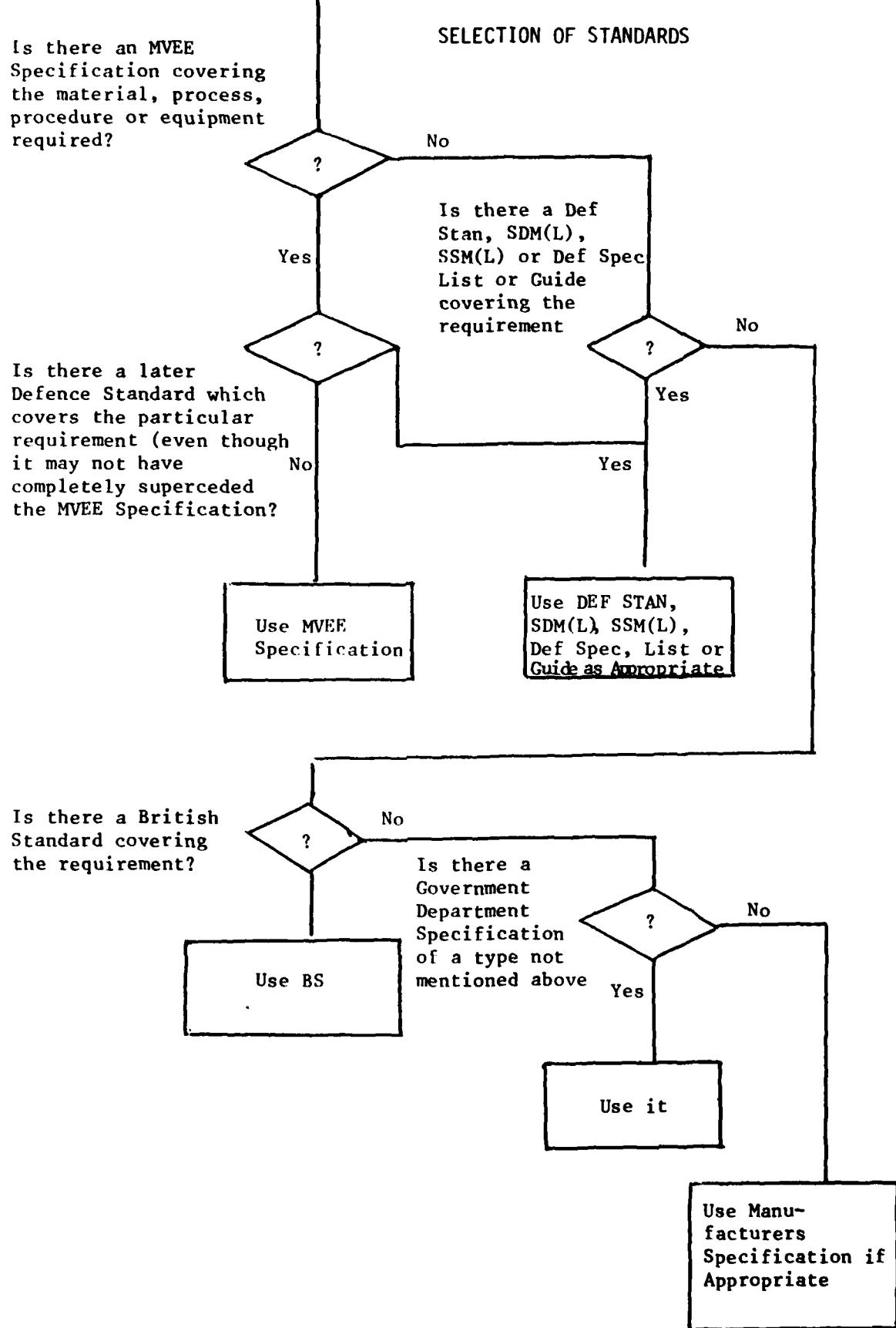
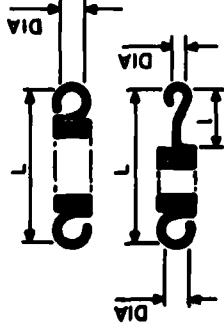
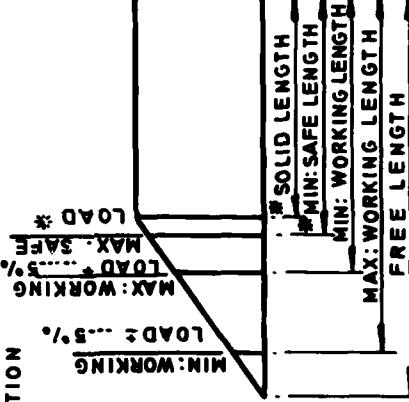
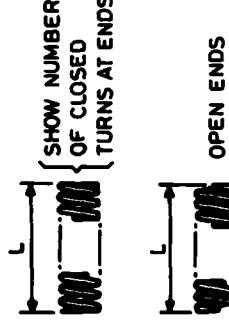
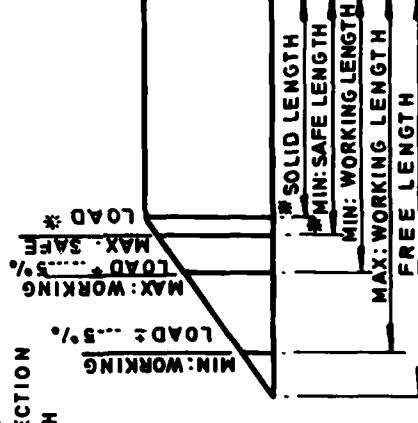
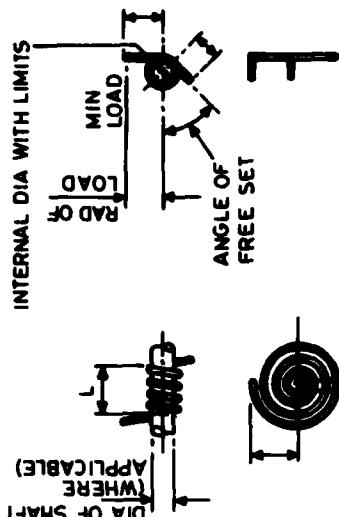
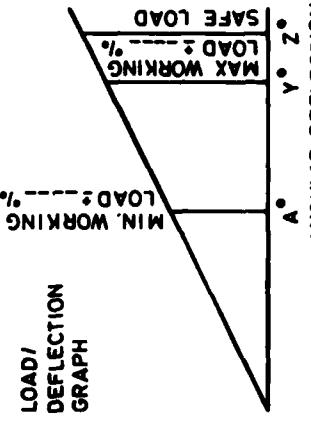


FIGURE B1

METHOD OF GIVING INFORMATION ON DRAWINGS FOR SPRINGS

(Section 13.3 refers)

**METHOD OF GIVING INFORMATION ON DRAWINGS FOR SPRINGS**

TENSION	COMPRESSION	TORSION
 <p><b>R.H. WOUND</b></p> <p>THE NECESSARY INFORMATION SHALL BE SELECTED FROM THE ITEMS BELOW IN ACCORDANCE WITH B S 1726</p> <p>(a) LOAD / DEFLECTION GRAPH</p>  <p>* AS APPLICABLE</p>	 <p><b>SHOW NUMBER OF CLOSED TURNS AT ENDS</b></p> <p><b>OPEN ENDS</b></p> <p>THE NECESSARY INFORMATION SHALL BE SELECTED FROM THE ITEMS BELOW IN ACCORDANCE WITH B S 1726</p> <p>(a) LOAD / DEFLECTION GRAPH</p> 	 <p>THE NECESSARY INFORMATION SHALL BE SELECTED FROM THE ITEMS BELOW IN ACCORDANCE WITH B S 1726</p> <p>(a) LOAD / DEFLECTION GRAPH</p> 

- (b) WIRE DIAMETER, FOR CIRCULAR SECTIONS, OR WIDTH (RADIAL) & HEIGHT (AXIAL) OF CROSS SECTION FOR RECTANGULAR SECTIONS (NOMINAL DIMENSIONS)
- (c) MEAN COIL DIAMETER
- (d) FORM OF END COILS REQUIRED
- (e) TOTAL NUMBER OF COILS END TO END
- (f) FREE LENGTH
- (g) MATERIAL
- (h) FREQUENCY OF OPERATION PER SEC (IF NECESSARY)
- (i) FINISH (IF NECESSARY)
- (j) FINISH

## GEAR DATA

(Section 14 refers)

### SPUR AND HELICAL GEAR DATA

NUMBER OF TEETH	
MODULE	
PRESSURE ANGLE	
HELIX ANGLE	
HAND OF HELIX	
WHOLE DEPTH OF TOOTH	
CORRECTION	
CONSTANT CHORD HEIGHT	
CONSTANT CHORD THICKNESS	
MATING GEAR PART No.	
CENTRES	
COMBINED BACKLASH	
GEARS TO B.S.436, CLASS (as applicable)	

### STRAIGHT & SPIRAL BEVEL GEAR DATA

NUMBER OF TEETH	
MODULE	
PITCH DIA	
SHAFT ANGLE	
PRESSURE ANGLE	
SPIRAL ANGLE	
HAND OF SPIRAL	
ROOT ANGLE	
ADDENDUM	
WHOLE DEPTH OF TOOTH	
CIRCULAR THICKNESS (THEOR)	
MATING GEAR PART No.	
No. OF TEETH IN MATING GEAR	
CONE DISTANCE	
COMBINED BACKLASH	
GEARS TO B.S.545, CLASS (as applicable)	

APPENDIX E to  
MVEE PROCEDURE 101

ARMOUR MATERIALS (SECTION 18 REFERS)

MATERIAL	SPECIFICATION
<b>ARMOUR STEEL</b>  Homogeneous machineable plate 15 mm nominal thickness and over  Armour quality castings  Homogeneous machineable armour plate 3 to 14 mm nominal thickness  Floor plates for AFV's  Armour quality forgings	MVEE IT 80F  MVEE IT 90G  MVEE IT 100E  MVEE IT 130B  MVEE IT 140A
<b>ARMOUR ALUMINIUM</b>  High strength heat treatable aluminium alloy armour plate, nominal thickness 6 to 120 mm  Homogeneous aluminium alloy armour extrusions of nominal section, 18 mm and over thick  Ingots and weldable non-armour sand castings for use in aluminium alloy armoured vehicles.	MVEE 1318B  MVEE 517  MVEE 567

SURFACE TEXTURE (SECTION 21 REFERS)

ROUGHNESS No. CLA Values	N1	N2	N3	N4	N5	N6	N7	N8	N9	N10
PROCESS										
Gauge grinding										
Diamond turning and boring, lapping polishing and superfinishing										
Fine grinding										
Honing, fine turning and boring										
Gear Shaving										
Broaching										
Shaping, hobbing planing, milling of gear										
Reaming and general grinding										
Finish turning, boring milling, planing, slotting shaping										
Precision die- casting extrusions etc										
Drilling										
Rough turning and general machining										

## GRAPHICAL SYMBOLS FOR ELECTRICAL PURPOSES

(Section 28.2.2 refers)

WHEN PREPARING WIRING DIAGRAMS THE GRAPHICAL SYMBOLS  
SHALL BE IN ACCORDANCE WITH B.S. 108, B.S. 530 AND THE  
FOLLOWING ADDITIONS, WHICH ARE REQUIRED FOR AUTOMOTIVE  
ENGINEERING

<p>1 ALL ASSEMBLIES TO BE SHOWN IN BOLD CONTINUOUS LINES ON BLOCK DIAGRAMS AND AS CHAIN DOT LINES ON MASTER DIAGRAMS</p>	<p>7 INTERIOR LIGHT COMPLETE WITH DIMMER AND SWITCH</p>
<p>2 WHEN ILLUSTRATING CABLES, THE THICKNESS OF THE LINE SHOULD BE COMPARABLE TO THE SIZE OF CONDUCTOR ACTUALLY USED THUS :-</p>	
<p>UP TO 24 AMPS</p> <p>50 - 75 AMPS</p> <p>100 AMPS UPWARDS</p> <p>MULTICORE UNSCREENED</p> <p>MULTICORE SCREENED</p>	<p>8 INSPECTION SOCKET</p>
<p>3 FLEXIBLE CONDUIT (BRAIDED)</p>	<p>9 PRESS TO TEST LAMP</p>
<p>4 ARMoured OUTLET</p>	<p>10 INTER-VEHICLE SOCKET</p>
<p>5 GLAND</p> <p>MASTER AND THEORETICAL DIAGRAMS</p>	<p>11 HEAVY DUTY CONNECTORS</p> <p>MASTER AND THEORETICAL DIAGRAMS</p> <p>BLOCK DIAGRAMS</p>
<p>6 DOUBLE FILAMENT LAMP</p>	<p>12 NIPPLE CONNECTORS</p> <p>MASTER AND THEORETICAL DIAGRAMS</p> <p>BLOCK DIAGRAMS</p>

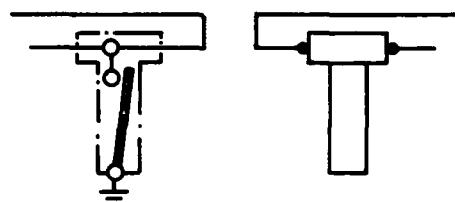
13

PROGRESSIVE SWITCH



14

FLAME SWITCHES



MASTER AND  
THEORETICAL  
DIAGRAMS

BLOCK  
DIAGRAMS

15

CURRENT LIMITER



MASTER AND  
THEORETICAL  
DIAGRAMS

BLOCK  
DIAGRAMS

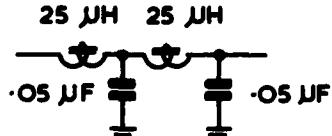
RATING TO BE SHOWN IN  
TOP LEFT HAND CORNER

16

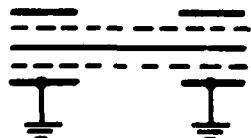
FILTER UNITS

ALL CHOKES AND CAPACITORS  
TO BE SHOWN

E.G.

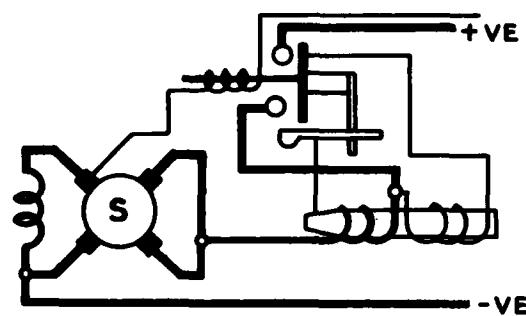
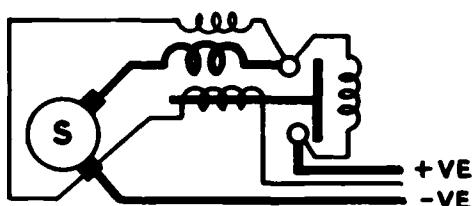


FERRITE TYPE  
FILTER



17

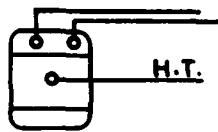
STARTER  
ELECTRICAL ENGAGEMENT TYPES



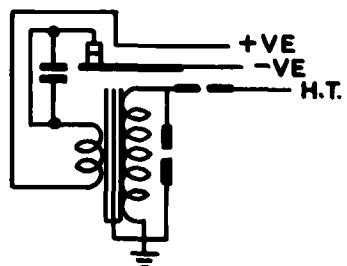
18

BOOSTER COIL

BLOCK  
DIAGRAMS

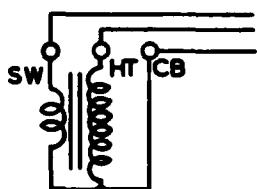


MASTER AND  
THEORETICAL  
DIAGRAMS



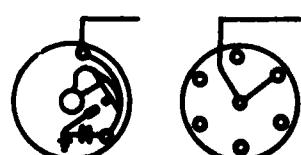
19

IGNITION COIL



20

DISTRIBUTOR



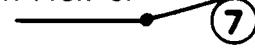
21

ROTARY BASE JUNCTION

BRAID PICK-UP



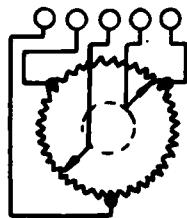
BRUSH PICK-UP



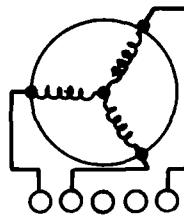
DETAIL EACH RING AS ABOVE  
AND MARK WITH RING  
IDENTIFICATION NUMBER  
BRAID OR BRUSH SHOULD BE  
SHOWN RIGHT OR LEFT HAND  
AS ACTUALLY OCCURRING

22

DESYNN TYPE TRANSMITTER

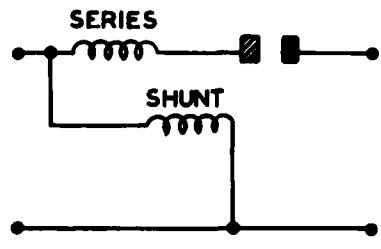


DESYNN TYPE INDICATOR



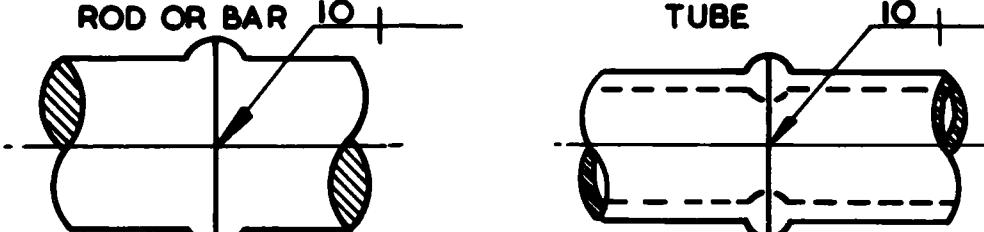
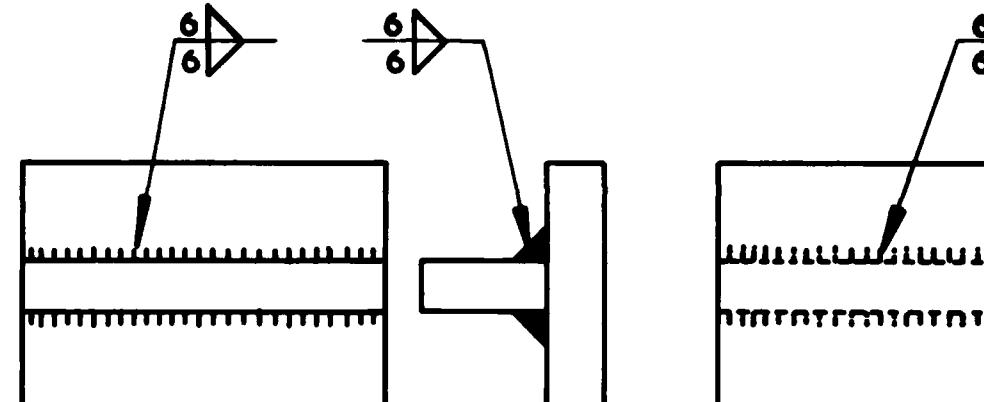
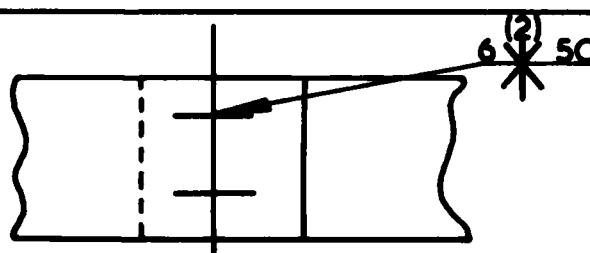
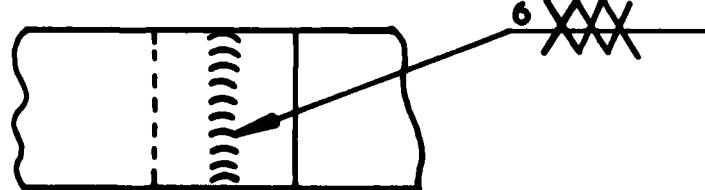
23

CUT - OUT



# DESIGNATION OF WELDS BY PICTORIAL REPRESENTATION

(Section 32 refers)

	<b>GENERAL NOTES</b> <ul style="list-style-type: none"> <li>(I) WELDS ON FAR SIDE TO BE SHOWN AS BROKEN LINES WHERE THIS IS NOT POSSIBLE A SEPARATE NOTE OR VIEW MAY BE ADDED</li> <li>(II) WELDS IN SECTION OR END ELEVATION TO BE SHOWN IN SOLID BLACK</li> <li>(III) SPECIAL PREPARATIONS ETC MUST BE SHOWN BY ADDITIONAL VIEWS &amp; / OR DESCRIPTIONS.</li> </ul>	
<b>BUTT WELDS</b>		
<b>FILLET WELDS</b>		
<b>SPOT WELDS</b>		
<b>SEAM WELDS</b>		

**DESIGNATION OF WELDS BY PICTORIAL  
REPRESENTATION**

(Section 32 refers)

FLASH WELDS		
STUD WELDS		<u>NOTE MAY BE ADDED TO INDICATE METHOD OF WELDING E.G. AUTOMATIC OR ARC ETC.</u>
STITCH WELDS		
PROJECTION WELDS		
INTERMITTENT WELDS		

STANDARD NOTES FOR APPENDING TO  
DRAWINGS OF FABRICATED PARTS (SECTION 32 REFERS)

COMPONENT MATERIAL(S)	METHOD OF WELDING	STANDARD NOTE
Weldable steels, 3 mm thick and over: Armour to armour Armour to non-armour Non-armour to non-armour	Arc Welding	Welding and Gas Cutting to conform to MVEE Spec 1031
Weldable steels under 3 mm thick Non-armour to non-armour	Gas, arc or spot welding Gas Welding Spot Welding	May be gas, arc or spot welded in accordance with MVEE Spec 1031 Gas welding to conform to MVEE Spec 1031 Spot welding to conform to MVEE Spec 1031
Weldable steel studs to weldable armour steel and non-armour steel	Automatic Stud Welding	Automatic Stud Welding Equipment and Procedure to conform to MVEE Specs 1031 and 1032
Weldable aluminium, 6 mm thick and over: Armour to armour Armour to non-armour Non-armour to non-armour	MIG Welding	Welding and Cutting to conform to MVEE Spec 1321. Use filler wire NG.....* or approved equivalent, to BS 2901, Part 4
Weldable aluminium under 6 mm thick:	MIG or TIG Welding	Welding and Cutting to conform to MVEE Spec 1321 or BS 3019. Part 1. Use filler wire NG.....* to BS 2901 Part 4

\*Compatible filler wires shall be quoted. Refer to MVEE Memorandum 77013. Further information is available from MVEE, FS/AM(A) Branch, Welding and Fabrication Section.

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